

## APPENDIX 2. HOW THE LIMITS ON LOAN PAYMENTS AFFECT VOLUMES OF HOUSING LOANS

Eesti Pank set requirements in March 2015 that the commercial banks have to abide by when issuing housing loans. These set a loan-to-value (LTV) limit of 85%, a debt service-to-income (DSTI) limit of 50%, and a maximum maturity for loans of 30 years. The Eesti Pank housing loan requirements are structural macroprudential measures by their nature and they were introduced in 2015 in an environment where the lending conditions of the banks were quite appropriate for the long-term risks in the lending market. The limits were calibrated for the lending conditions that would frame behaviour in the lending market if risks from loan growth were to increase, because of real estate prices rising for example. Research has looked at how the requirements affected the issue of loans in the subsequent years<sup>24</sup>.

It is assumed that the LTV limit has less impact on loan volumes as real estate prices rise than the DSTI limit does, and the analysis focused on estimating the impact of the DSTI limit in 2016-2021<sup>25</sup>. A distribution function analysis was used, which is a common method of estimating the impact of policy measures<sup>26</sup>. The distribution function of the DSTI ratio for new housing loans was used to estimate how many borrowers took loans with a smaller DSTI ratio to meet the requirements for housing loans, and how many borrowers were put off or did not receive loans because the DSTI ratio on the loan they wanted would have exceeded the limit.

Eesti Pank has been collecting data on loans since 2016 and as the distribution function for the DSTI on loans without the DSTI limit cannot be known, a set of possible distribution functions was simulated by applying the following assumptions: 1) the distribution function for the unlimited DSTI ratio is the normal distribution; 2) loans that would have had a DSTI ratio under 50% even without the limit are not affected by the requirements, meaning the volume of such loans does not change; 3) the DSTI limit affected loans that were taken under the new conditions with a DSTI ratio under 50%, and these fall into the part of the distribution function that is between the median DSTI and 50%. The second and third assumptions suggest that setting the requirement changed the shape of the distribution function in the part where the DSTI ratio is above the median, but did not affect the shape of the distribution function where the DSTI ratio is below the median.

All the suitable simulated distribution functions for the unlimited DSTI ratio were compared with the actual distribution functions in each quarter and the number of loans was calculated in two segments. The first was loans between the median value and the 50% limit, where borrowers probably took a smaller loan to bring the DSTI ratio distribution below the 50% limit, and the second was the right-hand end of the distribution, where loans are missing since they were not taken out because of the limit. Figure A2.1 illustrates the use of the distribution functions, where the first segment is marked as adjusted loans and the second segment is missing loans, so that loans lost can be calculated as the difference between missing loans and adjusted loans.

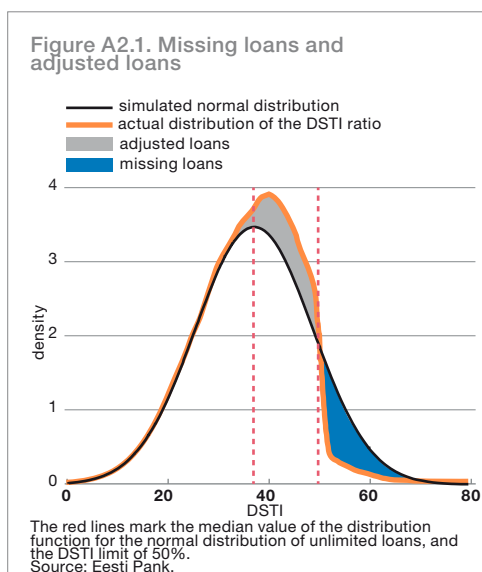
<sup>24</sup> Research to be published as Eesti Pank working paper no. X/2023: Kukk, M., Levenko, N. and Reigl, N. (2023) Borrower-based policy measures in Estonia: the effects of debt service-to-income ratio limits on new housing loans.

<sup>25</sup> The 50% DSTI limit is set using not the actual DSTI ratio but an estimated one that allows for a possible rise in interest rates, as it is calculated using either the interest rate in the loan contract plus two percentage points, or an annual interest rate of 6%, whichever is higher.

<sup>26</sup> A more thorough review of the use of the distribution function in analysing policy measures is given in Kleven, H. J. (2016). Bunching. *Annual Review of Economics*, 8, 235-464.

The results are presented in Table A2.1 by year. The DSTI limit is estimated to have affected 11% of loans in 2016-2021, as around 4-5% of loans taken were smaller than was wanted, and about 6% of potential loans were not taken. The shares of the two groups affected were relatively stable across the six years observed.

The number of loans affected can be used to estimate how the DSTI limit affected the amount of new loans<sup>27</sup>. The results are shown in the right panel of Table A2.1, as the volume of new housing loans taken in a year is around 10% smaller, with the decrease coming mainly from borrowers who did not take a loan, as lost loans reduce the amount by 8-9%. The volume of housing loans is 1-2% smaller as a consequence of adjusted loans that were taken for a smaller value. The share of loans affected by the limit has remained stable over the years, and so the impact on the volume of new loans has also been stable over the period observed.



**Table A2.1. Loans affected by the DSTI requirement and the effect on the volume of new loans**

Year	Affected loans			The effect on the volume of new loans (share of new loans granted)		
	Adjusted loans	Loans lost	Total	On the account of adjusted loans	On the account of loans lost	Total
2016	3.8	5.7	9.5	-1.3	-8.8	-10.1
2017	4.5	5.9	10.4	-1.9	-9.4	-11.3
2018	4.7	6.4	11.1	-1.5	-9.6	-11.1
2019	4.2	5.4	9.6	-1.0	-7.9	-8.9
2020	4.3	6.7	11.0	-0.6	-8.9	-9.5
2021	6.3	6.2	12.5	-0.8	-8.2	-9.0

**Table A2.2. The effect of the DSTI requirement on the stock of housing loans**

Year	Actual loan stock with the DSTI limit		Simulated loan stock without the DSTI limit		Difference
	Million euros	Yearly growth rate, %	Million euros	Yearly growth rate, %	% of actual stock
2015	6 323	4.3	6 437	6.1	1.8
2016	6 660	5.3	6 896	7.1	3.5
2017	7 106	6.7	7 499	8.7	5.5
2018	7 602	7.0	8 156	8.8	7.3
2019	8 118	6.8	8 811	8.0	8.5
2020	8 655	6.6	9 376	6.4	8.3
2021	9 449	9.2	10 438	11.3	10.5

<sup>27</sup> The impact on loan volumes assumes that the loans affected would have been the same size without the DSTI limit as the loans that have a DSTI ratio above the limit, meaning those that have received an exemption from the requirement.

The impact of the DSTI limit on the total volume of the housing loan portfolio was calculated using the smaller volume of new housing loans. The yearly growth in it was estimated to have been 1.5-2 percentage points smaller in 2016-2021, and by the end of 2021 the total housing loan portfolio was around 10% smaller than it would have been without the DSTI limit. This analysis suggests that the DSTI limit has been an effective measure for reducing the risks from lending, and its impact has been stable over the years. This applies both in 2016-2019, when wages were increasing at the same rate as real estate prices, and in 2020-2021 when real estate prices rose notably faster than wages.